Space Weather Technical Forecast

Issued on Monday, 16 May 2022 at 01:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 radio blackouts becoming increasingly Likely. Slight Chance of G1/Minor Geomagnetic Storm, mainly day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with an isolated M2.2 flare at 15/0008 UTC from an active region beyond the northeast limb. There are six numbered and one un-numbered sunspots on the visible disc. AR3007 continues as the largest and most complex area and AR3013 as the second largest. The remaining sunspot groups are less complex and mostly unchanged over recent hours. There remain numerous small filaments on the disc. No other Earth directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, became elevated early in the period. This is considered to be the earlier than anticipated arrival of the coronal hole high speed stream. The IMF was often at Moderate strength, with a peak of 14nT at 15/0024UTC followed by a slow, erratic settling thereafter to near 10nT. The north-south component showed fluctuating periods of north/south orientation, peaks between +9 and -10nT, with the longest period of southward orientation between midnight UTC and 15/0300 UTC. The phi angle was mostly positive (away from the Sun), with a few brief negative (towards the Sun) switches at the start of the period. The net effect of these solar wind measures was mostly Quiet to Unsettled (Kp 1 to 3) conditions, but with Active (Kp 4) periods observed between 15/0000-0600 UTC by NOAA SWPC and Potsdam.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has remained predominantly at Normal Background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu) threshold on a current level trend. Observed fluence at 16/0000 UTC was 1.18e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain at Low to Moderate levels, with M-class flares becoming slightly more Likely over the next few days owing to potentially further active regions rotating around the northeast limb, and a Slight Chance (5%) of an X-class flare.

Solar Wind / Geomagnetic Activity: No CMEs currently feature in the forecast. The presently elevated solar winds indicate the earlier than anticipated arrival of the high speed stream from positive polarity CH81/+, This is considered to be the only expected enhancement of the solar wind due in the four day period with a gradual decline predicted, and an increasingly Quiet outlook in geomagnetic activity is forecast as the period progresses.

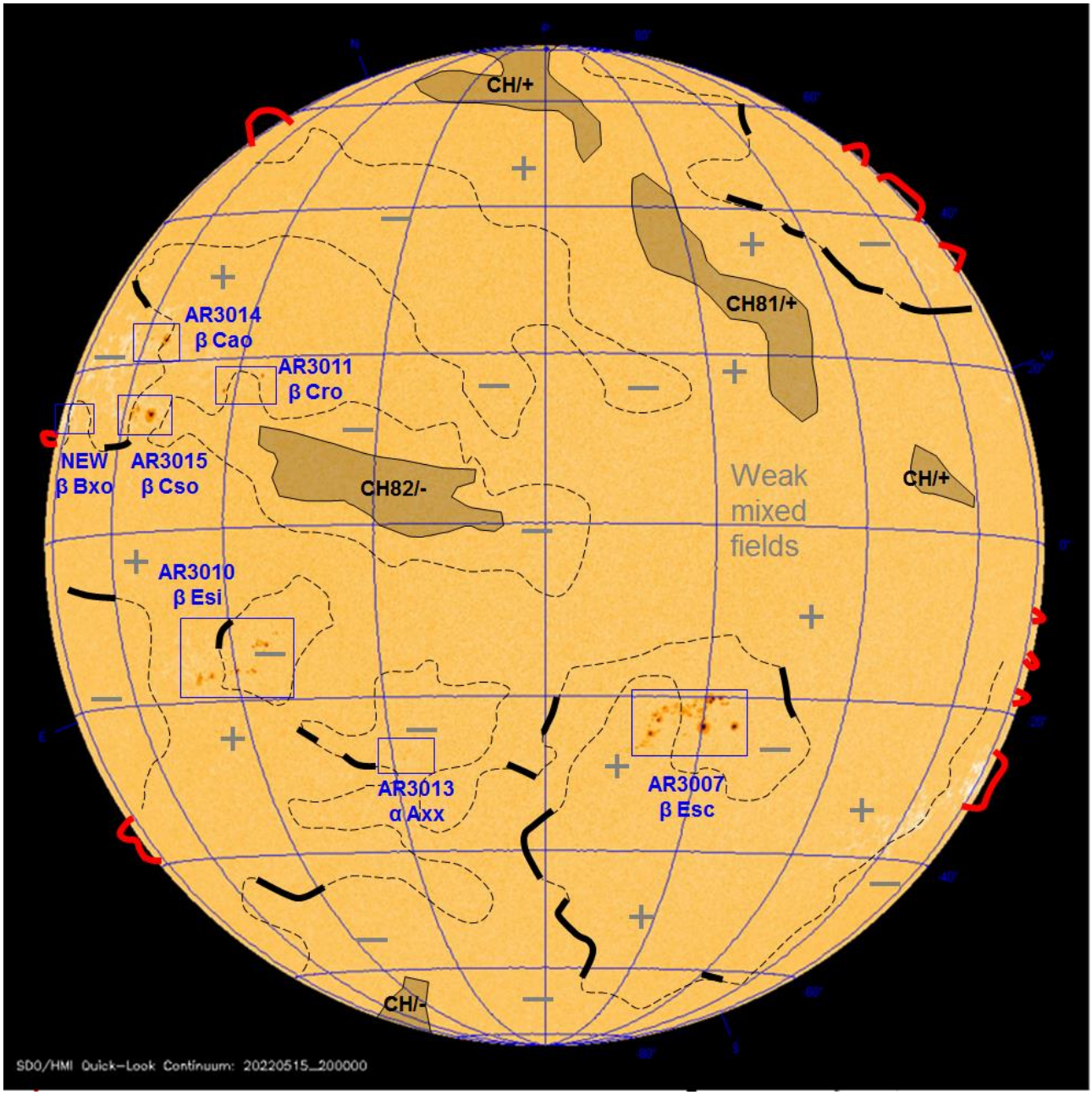
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

expected to be at background levels during this period, although there is slight risk of an S1 or greater event, mainly due to AR3007 as it transits west from a central location. The high energy electron flux (greater than 2 MeV) is forecast to remain at Normal Background to Moderate levels at first, but may rise over the next few days, with an increased chance of the diurnal peak reaching High levels. The 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold during the forecast period, but with a likely rising trend.

Figure 1. Solar Analysis Valid 2000UTC, 15 May 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

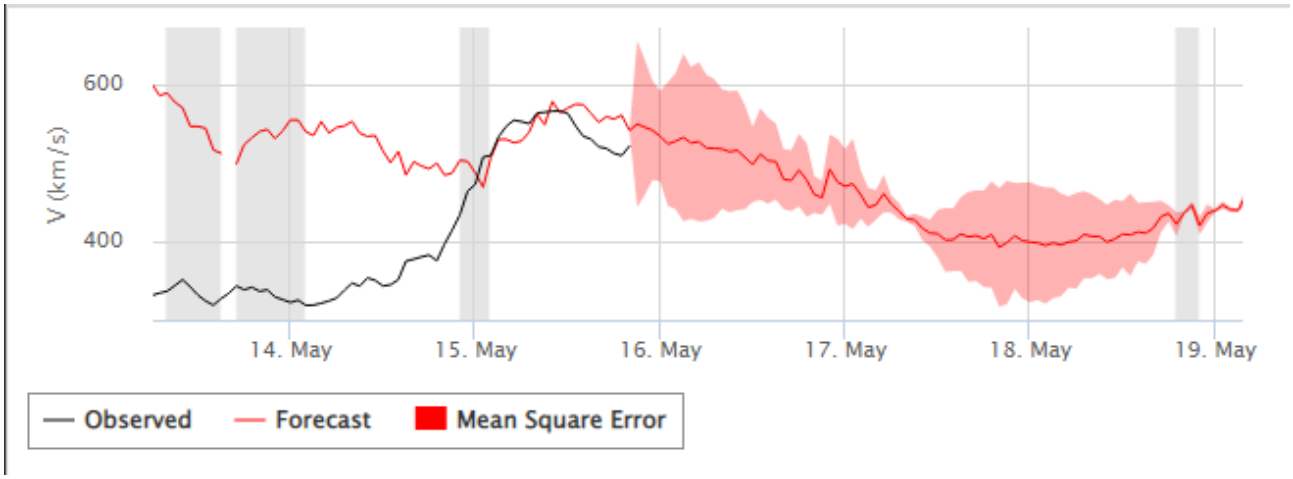
No Earth-bound Coronal Mass Ejections (CMEs) currently feature in this forecast period.
Solar winds in the past 24 hours indicate the earlier than anticipated arrival of the high speed stream from positive polarity coronal hole 81. There is also an indication of similar influence from STEREO A MAG and PLASTIC traces around 2.5 days upstream of Earth in the Parker spiral. Relative to earlier guidance. This is the only expected enhancement of the solar wind due in the four day period, and an increasingly Quiet outlook for geomagnetic activity is therefore expected as the forecast period progresses.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model, indicating a slow decline likely in the next few days.



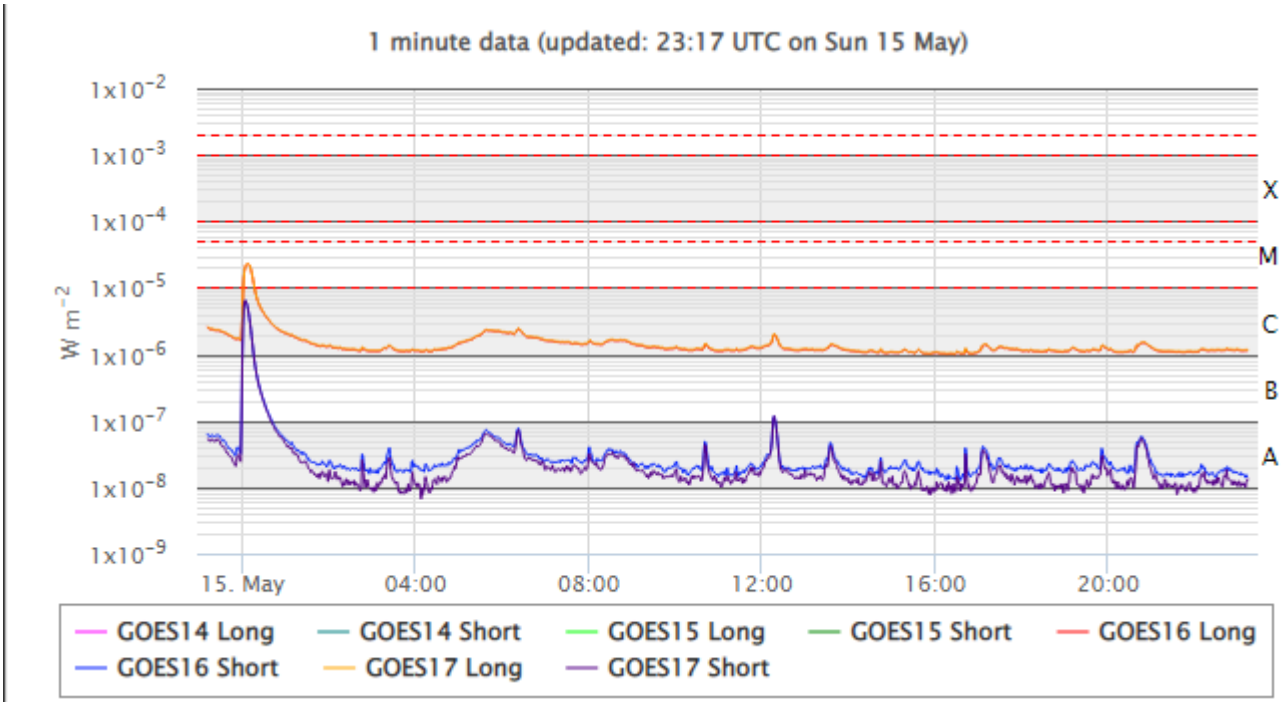
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
The Earth facing side of the solar disc is likely to see a further increase in the number of sunspot regions in the period, as potentially further active regions rotate around the northeast limb into the coming UTC working week. The exact contribution from these is uncertain, but they are likely to more than compensate for the loss of AR3006 early in the period, with this group having faded as it approaches the southwestern limb Therefore, there is a slightly increasing risk of M-class flares, with a similar slight increase in the probability of isolated X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	50	60
Very Active	R3 to R5 X Class	No	5	5	10	20

Figure 3: X-ray flux plot over the past 24 hours at GEO with the M-class flare at the start of the day, and isolated C-class flares observed thereafter.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

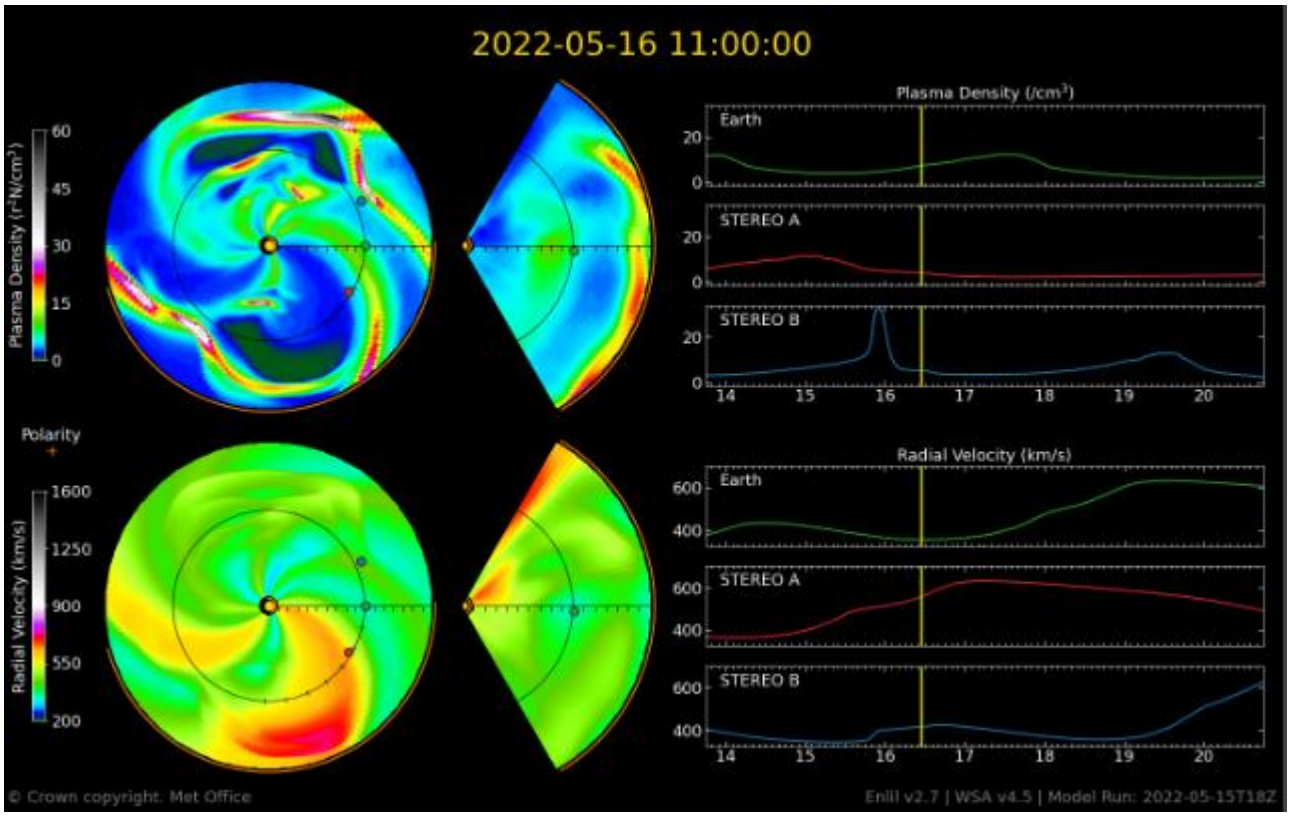
© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is close to Background levels and is generally expected to remain at that level throughout the period. However, there is a slight chance of an S1 or greater event during the forecast period, primarily due to AR3007 as it transits westwards towards the western limb of the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Met Office ENLIL model for Earth with the elevated solar winds not being captured currently in comparison to data at L1.



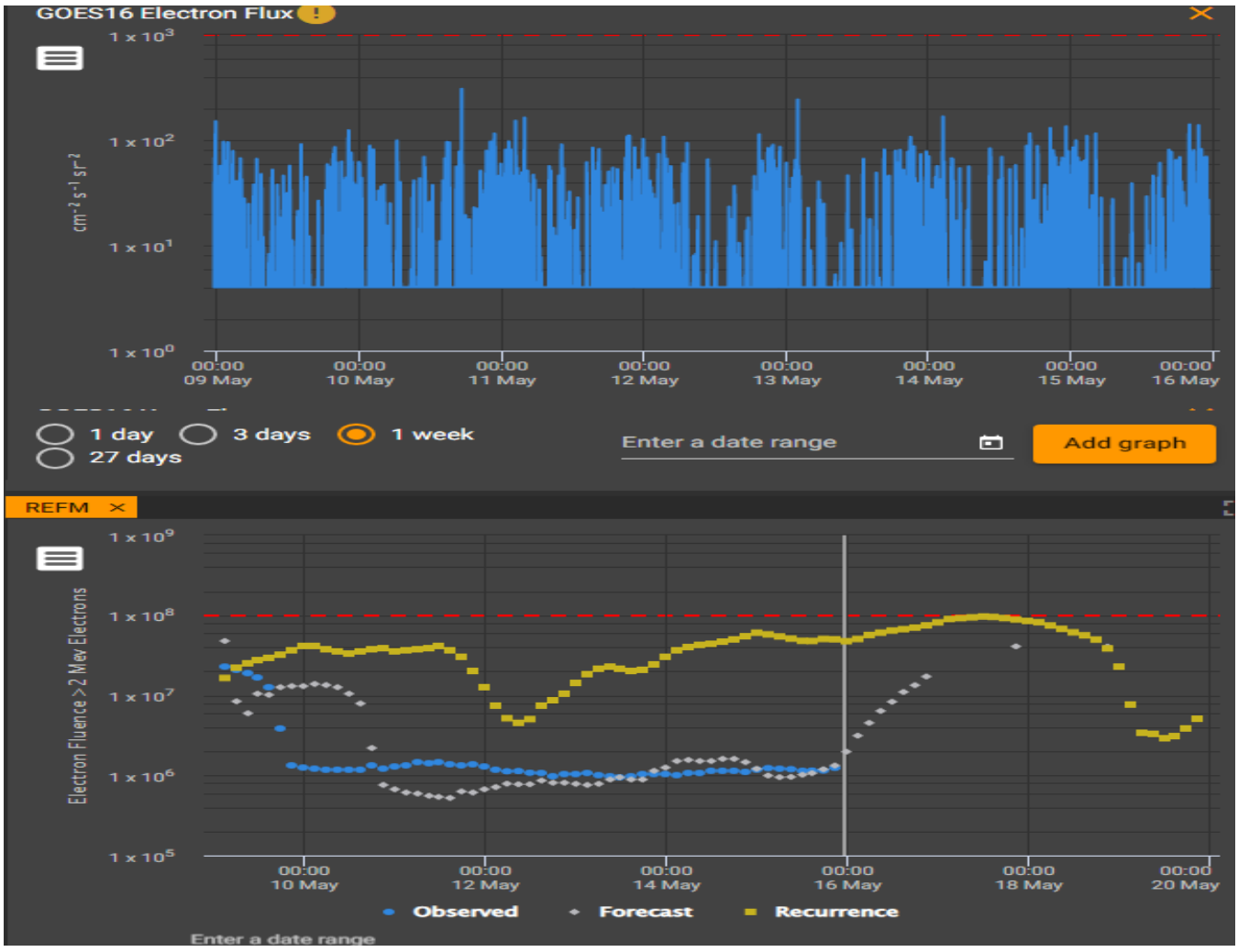
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) is currently at Normal background to Moderate levels, but may rise over the next few days due to high speed stream influence from CH81/+ , which arrived earlier than anticipated.
The corresponding electron fluence is therefore expected to show an upward trend through the period, however on balance will most likely continue below the Active (1e8 integrated pfu) threshold. This is reflected by current REFM output and in the probabilities table above.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	20	30	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux and Met Office REFM output over the past week.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.